Original Article

Retrospective study of severe acute malnourished children in nutrition rehabilitation center of Madhya Pradesh, India: Management and outcome

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ABSTRACT

Introduction: Nutrition rehabilitation centers (NRCs) are established for optimal management of severe acute malnourished (SAM) children. Results of different NRCs vary in terms of outcome. **Objective:** The objective of the study was to know the morbidity and outcome pattern of SAM children. **Materials and Methods:** SAM children aged 0–59 months admitted during 2 years period in NRC of district hospital (secondary care center) of central India were enrolled in the study. Data of these children such as age, sex, weight on admission and discharge, complications, treatment, and outcome were studied. **Results:** A total of 993 children were admitted during 2 years April 2016–March 2018. Male children were 530 (53.37%) and female were 463 (46.62%). 93 (11.17%) children had mid-upper arm circumference <11.5 cm (<2 standard deviation [SD]), 464 (45.5%) were of <3SD and 436 (43.39%) were of < 4SD. A total of 49 (4.93%) children were aged <6 months, 366 (36.85%) between 7 and 12 months, 455 (45.82%) between 13 and 24 months, and 123 (12.38%) children were of >24 months of age. A total of 799 (80.46%) had associated medical complications and 521 (52.46%) children were admitted in the ward for stabilization and treatment of medical illness. 182 (18.32%) children were send back to corresponding NRC after stabilization while 50 (5.03%) were referred to a tertiary care center. From a total of 761 children in NRC, 594 (78.05%) improved, 60 (6.04%) were did not respond, 118 (15.5%) were defaulter, and 6 (0.6%) children died during treatment. The average duration of stay was 10.16 days and average weight gain was 10.01 g/kg/day. **Conclusion:** Besides, the target of reducing the prevalence of SAM, NRC is very important center for reducing under-five morbidity and mortality. To achieve the target to end up malnutrition, more NRCs should be started with the increasing capacity of existing NRCs with consideration of community-based model.

Key words: *Severe acute malnutrition, Mid-upper arm circumference, Nutritional rehabilitation center*

Wasting in children is life-threatening result of hunger and/disease. Children suffering from the wasting have weakened immunity, susceptible to long-term development delay and face the increased risk of death. They require urgent treatment and care to survive. Globally, 52 million children under 5 years of age were wasted (prevalence 7.7%) and 17 million were severely wasted (prevalence 2.5%) in 2016. Every year, undernutrition contributes to the death of around 3 million children worldwide [1]. The case fatality rate of untreated severe acute malnutrition (SAM) is 23.6%. In 2016, more than half of all the wasted children lived in South Asia. With 16% prevalence, South Asia's wasting represents a critical public health emergency [1].

As per data of NFHS-4, India is having a large burden of underweight and undernourished (35.7%) children and 7.5% of children were severely wasted with under five mortality of 50/1000 [2]. In India, the percentage of SAM has increased as compared to the prevalence in the past decade of 6.4% (NFHS- 3-2005-06) [3]. In the state of Madhya Pradesh (MP), the prevalence of SAM has reduced from 12.6% in 2005–2006 to 9.2% in 2015–2016. The current prevalence of 9.2% translates approximately 9.2 lakh children with SAM at any given point of time in MP. MP is the first state of India to establish facility-based treatment for SAM by establishing nutrition rehabilitation center (NRC) in Guna and Shivpuri districts in 2006–2007. At present, the state has 317 NRC which is providing care and treatment to the SAM children as per the IAP and WHO 2009 recommendations. The objective of the program is to control malnutrition among the children <5 years in the state and to bring down the prevalence of SAM children to <1% [4].

As per the NFHS-4 data, Khandwa district of state MP is having 46.8% underweight children, wasting in 27.5% and severe wasting in 6.6% children. SAM children have many complications such as diarrhea, pneumonia, and sepsis; hence, the recovery varies in these children. Recovery rate may vary in different NRCs [5-7]. Therefore, this study was conducted in admitted children of Khandwa district hospital NRC of 2 years period (April 2016–March 2018) to find morbidity/outcome pattern of SAM children.

MATERIALS AND METHODS

This retrospective observational study was done, with due permission from ethical authority, for a period of 2 years from April 2016 to March 2018 at a 20 bedded NRC of District Hospital Khandwa (secondary care level hospital) of state MP, India which is run with the help of WHO/UNICEF. In Khandwa district, there are 9 NRC running in 6 blocks (Tehsil place) (including the study center) having the capacity to provide care to 2640 SAM children per year. NRC at district place provides facility-based care to children of the district and nearby villages as well as to children referred from NRCs of primary health centers.

This NRC is staffed with a medical officer and other support staff (feeding demonstrator [FD], caretakers, ANM, staff nurses, and cook) with a separate premise. It also has investigation facilities such as complete blood count, chest X-ray, urine and stool routine and microscopic test, liver and renal function tests, computed tomography scan, malaria test, Mantoux test, sputum for acid-fast bacillus, and whole blood transfusion facility. District NRC lacks facilities of tertiary care center such as magnetic resonance imaging, blood culture and sensitivity, and blood component transfusion facility.

Children were enrolled on the basis of the WHO/UNICEF criteria of SAM for children aged 6–59 months, i.e., any one of the following criteria: Weight for height (Wt/Ht) ratio <3 standard deviation (SD), mid-upper arm circumference (MUAC) <11.5 cm, and/or bilateral pitting edema. For children <6 months of age any one of the following criteria suggested SAM:W/H ratio <3SD, bilateral pitting edema, failure to gain weight, and poor feeding. Apart from the above, since past 5 years, we have started to notify SAM children who were Wt/Ht ratio <4 SD or MUAC <10 cm at the time of admission, to quickly assess the threatening gravity of mortality and for the urgency of treatment.

Sick children with medical complications were treated in the pediatric ward for initial stabilization. After stabilization, they were subjected to NRC protocol [8]. Children were given NRC diet F-75, F-100, and special feed with other supplements as per the protocols. During NRC stay, medicines and micronutrients were given to children as per the NRC protocol. Weight, height, and MUAC were measured at the time of admission as per the standard guidelines. The WHO reference chart was used to assess the W/H ratio. Daily weight measurement was done at a fixed time using a single standardized weight scale provided by UNICEF, whose daily calibration is done in the morning. During NRC stay, mothers were taught about the hygiene, child care, and feeding practices and given compensation for daily wage loss during stay [9].

Few children having other comorbid conditions such as congenital/metabolic/central nervous system (CNS)/cardiac, surgical, and undiagnosed complications were referred to tertiary center Indore for further management. Some children were sent back to the corresponding NRC of Primary Health Care (PHC) for further management after initial stabilization, and when they were free of medical complications and started gaining weight. This group was considered as improved, and further follow-up of these children was done in their corresponding NRC. Children referred to tertiary center, and those sent back to corresponding NRC were excluded from the output indicators of our NRC.

Weight has been taken as the main anthropometric measure for the outcome, because the improvement in the weight of SAM children has the most significant effect in reducing the mortality among them. During stay and follow-up, average weight gain (g/kg/day) was noted. Children were divided into three categories according to the duration of stay of in NRC: (1) <7 days, (2) 7–14 day, and (3) >14 days was recorded. Blood transfusion to children, Mantoux test, and anti-tubercular treatment given was noted. Children were discharged from NRC as per the guidelines, i.e., satisfactory weight gain, free of medical complications, and starting weight gain after free of edema. Follow-up of SAM children discharged from NRC was done at an interval of 15 days for 2 months and output was assessed as cured, defaulter, death, and non-respondent.

RESULTS

A total of 993 children were admitted in NRC during the study period; out of them, 530 (53.37%) were males and 463 (46.62%) were female. A total of 53 (5.33%) children had bilateral pitting edema. 93 (11.17%) children had W/H ratio <2 SD, MUAC <11.5 cm, and/or bilateral pedal edema. 464 (45.5%) children had W/H ratio <3 SD and 436 (43.39%) children had W/H ratio <4 SD. A total of 181 (18.22%) children had MUAC <10 cm. Age-wise distribution of children is presented in Table 1. 317 (37.12%) children were from Khandwa city and village area, 368 (37.05%) from Khalwa Block, 78 (14.4%) from Pandhana Block, and 165 (16.61%) from other four blocks (Mundi, Chhegaon Makhan, Harsud, and Killod). Out of 436 children with W/H ratio <4 SD, 205 (47.01%) children were from Khalwa (Tribal) block.

Most of the children, 80.46% (n=799) had associated medical complications as shown in Table 2. Majority of them had diarrhea (22.4%), pneumonia (18.27%), and anemia (8.26%) or had more than one of these (12.89%). A total of 521 (52.46%) children were treated in the pediatric ward, stabilized and then subjected to NRC protocol. A total of 263 (60.59%) out of all 434 children with W/H ratio <4 SD and 188 (40.51%) out of 464 children with W/H ratio <3 SD required admission in pediatric ward for the management of associated complications. Blood transfusion was given to 66 (6.64%) children with severe anemia having hemoglobin <4.0 g% and to other 193 children having Hb >4 g% along with associated complications like pre-infantile tremor syndrome, sepsis, or pneumonia, as per the WHO guidelines [11].

A total of 50 (5.03%) children having other comorbid conditions were referred to a tertiary center for the further management (neurological CP/MR/other CNS cases 12, surgical cases 13, congenital heart disease 9, non-respondent 5, septicemia 4, and one case of each of Down's syndrome, retinoblastoma, and pancytopenia). Duration of stay of referred cases in NRC was 33 children <7 days, 13 children between 8 and 14 days, and 4 children of sepsis and non-responders had a duration of stay >14 days.

Table 1: Age-wise distribution (n=993)

W/H ratio	<6 month	7–12 months	13–24 months	>24 months	Total (%)
<2SD	2	46	31	14	93 (9.36)
<3SD	23	154	221	66	464 (46.7)
<4SD	24	166	203	43	436 (43.9)
Total (%)	49 (4.93)	366 (36.85)	455 (45.82)	123 (12.38)	993 (100)

SD: Standard deviation

Table 2: Disease wise distribution (n=799)

W/H ratio	Median and <2 SD	<3 SD	<4 SD	Total (%)
Disease				
Diarrhea	11	87	81	179 (22.40)
Pneumonia	12	62	72	146 (18.27)
HB <4 g%	12	24	30	66 (8.26)
Mixed infection Diarrhea±Anemia±Pneumonia	12	34	57	103 (12.89)
Malaria	9	30	26	65 (8.13)
ATT given	3	20	24	47 (5.88)
Septicemia	2	10	29	41 (5.13)
Pre infantile tremor syndrome	5	11	20	36 (4.50)
Metabolic	1	1	2	4 (0.5)
Neurological (cerebral palsy/mental retardation/others)	4	21	43	68 (8.51)
Congenital heart disease	1	3	9	13 (1.62)
Surgical and other's	4	14	13	31 (3.87)
Total	76	317	406	799 (100)

SD: Standard deviation

A total of 182 (18.32%) children were referred back to their respective NRC after treatment of medical complications and stabilization. Of these, 96 (52.74%) children were W/H ratio <4 SD and 72 (39.56%) had W/H ratio <3 SD. These cases were considered improved in our study while considered cure in other study [10]. Duration of stay of 303 children in NRC was <7days (30.51%), 552 children (55.58%) 8–14 days, and 138 (13.89%) children had a duration of stay >14 days. The average duration of stay of all children was 10.16 days. After excluding referred cases (50 to higher center and 182 to respective NRC), a total of 761 children were considered for rehabilitation and follow-up phase in NRC Khandwa.

A total of 6 children (all W/H ratio <4 SD) expired during treatment within 7 days of admission. One case was of CHD with Down's syndrome, 5 cases of septicemia with shock. Age of one case was 3 years, and other 5 cases were <24 months old. Mortality rate was 0.60%.

A total of 118 (15.50%) children defaulted during the study period, 46 (38.98%) from NRC and 72 (61.01%) during follow-up. Total 60 (6.04%) children were non-responders (44 cases with W/H ratio <3 SD, 6 cases with W/H ratio <4 SD, and 10 children with MUAC <11.5 cm and of pedal edema). 594 (78.05%) children were cured out of 761 (gained >15% weight of admission). 263 (83.49 %) children with W/H ratio <4 SD cured out of 315 children and 270 (73.66%) cured out of 367 children with W/H ratio <3SD. Out of total cured 594 children, 395 (66.49%) cured in NRC and 199 (33.50%) during follow-up (Table 3). Average weight gain of cured children was 12.5 g/kg/day during NRC stay and 3.0 g/kg/day during follow-up. Average weight gain of all 993 children during NRC stay was 10.01 g/kg/day.

DISCUSSION

The number of children in our study was 993. The sample size of studies done by Dhanalakshmi *et al.* was 736 [10], by Mitulkumar was 98 [12], Taneja *et al.* were 100 [13]. Drop out (defaulter) rate, in our study, was 15.5% (118 children of 761) which was almost similar to the norms (should be <15%). It was 12.09% in a previous study [10] and 30% in a study conducted in Andhra Pradesh [14]. The death rate in our study was 0.60% (should be <5%) while it was 6.52% and 9% in previous studies [10,14], which were conducted in tertiary care centers. Low death rate in our study is because 50 patients with comorbid conditions were referred to tertiary care center.

Non-responders (not gaining 15% weight of admission after 4 follow-up) in our study were 6.04% (60 children) as compared to 19% in a study conducted by Manjula *et al.* [14] and 57.4% non-weight gain category in a study conducted in Indore, MP [15]. Out of these 60 non-responders, 44 (73.33%) had W/H ratio <3 SD, 10 (16.66%) were having pedal edema, and/or MUAC <11.5 cm. Only 6 (10%) non-responders had W/H ratio <4 SD. Cause of non-response may be reductive adaptation and latent infection in SAM, resulting in poor appetite. However, in a study by Manjula *et al.* [14], they found infections such as pneumonia, sepsis, and congenital heart diseases as a cause of it and study conducted in

Aurobindo Hospital [15], they pointed to lack of health education, sanitation, etc., as the cause of poor weight gain during follow-up.

Maximum percentage of SAM children admission was in the age group of 7–24 months 82.67% (n=821). In a study by Dhanalakshmi *et al.,* 50.95% children and in a study by Rawat and Marskole at Bhopal, 76.14% children were aged <24 months [10,16]. This age group has a maximum number of SAM admission, due to lack of proper supplementary feeding after 6 months. This correlates with NFHS-4 data of Khandwa district having only 2.7% of children getting adequate diet during 6–29 months. However, in our study, written record of dietary history was not available.

The average duration of stay of all children was 10.16 days. Stay of children in NRC for <7 days was found in 303 (30.51%) children; of these, the majority of the children were referred to a higher center and few improved and send back to NRC of block and PHC. Most of the children with B/L pedal edema and sepsis required treatment for >14 days (138, 13.89%). In our study, 799 (80.46%) children had medical complications at the time of admission. A study by Dhanalakshmi *et al.* had found medical complications in 72.91% children [10].

In our NRC, we used to record children of MUAC <10 cm and W/H ratio <4 SD, right at the time of admission, for identifying very severe wasting and critical illness. Out of 181 of MUAC <10 cm, 162 children had W/H ratio <4 SD. This correlates with the association of severe wasting with MUAC. This observation of our study suggests the role of MUAC as an easy tool for screening SAM at the community level for identifying severe wasting. However, a study done by Dasgupta *et al.* indicates a poor association of W/H ratio with MUAC because of the prevalence of stunting in Indian children [17]. Further studies may clarify this aspect.

Most children of underlying serious medical complications like pneumonia, CHD, septicemia, pre-ITS, neurological cases were having very severe wasting (W/H ratio < 4SD) at the time of admission as shown in Table 2. At the time of admission, most children of underlying serious medical complications had W/H ratio <4 SD. This shows that these diseases cause a serious threat to children with SAM leading to very severe wasting and necessity of the urgent treatment. This indicates the importance of notifying SAM children with W/H ratio <4 SD at the time of admission by NRC staff, to give them priority for management to prevent mortality.

Cure rate of our NRC was 78.05% (n=594 out of 761). The overall cure rate of total admission 993 was 59.81%, which is acceptable as per the NRC norms (50–75% acceptable and >75% considered good). Cure rate varies among different studies ranging from 41% [14] to 66.3% [16] as shown in Table 4. Average weight gain of cured (n=594) children in NRC was 12.5 g/kg/day and during follow-up was 3 g/kg/day (>8 g/kg/day during NRC stay is considered good). There is wide variation in average weight gain in studies of Gaboulaud *et al.* [18] and Khanum *et al.* [19]. In our study, cure rate of children of very severe wasting (< 4 SD) is higher (83.49 %) as compare to cure rate of severe wasting children (< 3 SD) which is (73.56 %). As per the analysis of 25 years of community-based management programs of SAM children (during 1980–2005) by Ashworth, rapid weight gain occurs when children are wasted, when a child approach normal W/H, his rate of weight gain falls to 1–2 g/kg/day [20]. Above analysis [20] explains high cure rate of children of very severe wasting in NRC and low rate of weight gain of all children during follw-up.

Despite uniform management protocols, variation in cure rate and weight gain pattern of different NRCs is most probably due to a variety of medical complications in admitted SAM children and place of management, because secondary and tertiary care centers have to manage more complicated referred SAM children from the periphery. In our NRC, we have found good results in terms of the outcome of SAM, due to the early identification and priority based management of children of MUAC <10 cm and W/H ratio <4SD.

Most cases of diarrhea and pneumonia (n = 203) were admitted in 3 months of July, August, September. It seems that during

Table 3: Outcome of children admitted in NRC (n=993)

SD	Admission	Referred to tertiary center	Referred back to NRC	Treated in NRC	Defaulter		NR	Cure		Total cure	% cure n=761
					NRC	Follow-up		NRC	Follow-up		
MUAC <11.5	93	14	00	79	3	4	10	37	24	61	61/79 (77.21)
W/H ratio <3SD	464	25	72	367	20	32	44	165	105	270	275/367 (73.56)
W/H ratio <4SD	436	25	96	315	23	36	06	193	70	263	263/315 (83.49)
Total	993	50	182	761	46	72	60	395	199	594	594/761 (78.05)

SD: Standard deviation, NRC: Nutrition rehabilitation center, MUAC: Mid-upper arm circumference

Table 4: Cure rate seen in different studies

No	Study (reference no)	NRC location	Sample size	Cure rate (%)
1	Dhanalakshmi *et al*. [10]	Tertiary hospital	736	81
2	Manjula *et al*. (AP) [14]	Tertiary hospital	100	41
3	Aurobindo hospital [15]	Tertiary hospital	300	42.6
4	Bairagadh Bhopal [16]	Civil hospital	102	66.3
5	Taneja *et al*. [13]	Primary care centers	91	53.76
6	Present study	District hospital	993	78.05

rainy season, due to illnesses and resulting weight loss, many children swing between wasting and severe wasting and threaten in malnutrition – Infection cycle. This is a major challenge in malnutrition control.

The recent introduction of hib, rotavirus and pneumococcal vaccine by government of India with the program to improve sanitation will greatly contribute to reduce the burden of undernutrition and associated medical complications in children such as diarrhea and pneumonia. In UN general assembly declaration on April 1, 2016, "UN decade of action on nutrition for a period of 2016–2025" and in International Conference on Nutrition Rome declaration, have a target to end all forms of malnutrition by 2030 as agenda for sustainable development [21].

Government is rapidly establishing new NRCs (during the past 10 years, 317 NRCs are established in the state of MP). In MP, even with 100% bed occupancy, existing facilities are equipped to treat 90,000 SAM children per year. So at any given point of time, 8.3 lakh children with SAM are left untreated in society. Thus, NRC cannot be the only tool to combat malnutrition. As suggested by Grobler-Tanner and Collins, a new approach of linking of NRC with core model of community-based management of SAM children can be considered [22].

This study has limitations that it is a record based study conducted in a hospital setting; therefore, supplementary feeding practices and the previous record of illnesses and treatment of children before admission in NRC were not available, which might affect the outcome of SAM in NRC. This study was done in single NRC of the district hospital, while studies in multiple NRCs of state will give more composite view about the outcome and importance of NRCs in reducing the prevalence of SAM.

CONCLUSION

Our study concludes that NRCs are essential for, not only reducing the prevalence of SAM in the community but also for the treatment of related illnesses, thus reducing under-five morbidity and mortality. This study also adds the importance of early identification and priority based management of very severe wasting in SAM children.

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